

IN THE CLAIMS:

Please cancel Claims 17 to 20, 22, 24 to 26, 28 to 30 and 44 without prejudice to or disclaimer of the subject matter presented therein. Please amend Claims 4, 5, 14, 15, 21, 23, 27, 31, 32, 35, 36, 39 and 40 to 42 as shown below. The claims, as pending in the subject application, read as follows:

1. (Previously Presented) A semiconductor device in which a switching element for allowing a current to flow to a load and a circuit for driving said switching element are formed on a common substrate,

wherein said switching element is a first insulated gate transistor which comprises:

a first semiconductor region of a second conductive type disposed at one main surface of a semiconductor substrate of a first conductive type;

a second semiconductor region of the first conductive type disposed within said first semiconductor region;

a first gate electrode disposed on a surface in which a pn junction between said second semiconductor region and said first semiconductor region terminates, through an insulating film;

a first source region of the second conductive type which is disposed on one end portion side of said first gate electrode within said second semiconductor region; and

a first drain region of the second conductive type which is disposed within said first semiconductor region; and

wherein said circuit for driving said switching element comprises a second insulated gate transistor having a characteristic different from that of said first insulated gate transistor.

2. (Original) The semiconductor device as claimed in claim 1, wherein said second insulated gate transistor constitutes a level shift circuit that generates a drive voltage applied to said first gate electrode.

3. (Original) The semiconductor device as claimed in claim 1, wherein a drain region of said second insulated gate transistor includes a low impurity concentration region.

4. (Currently Amended) The semiconductor device as claimed in claim 1, wherein said second insulated gate transistor constitutes a level shift circuit that generates a drive voltage applied to said first gate electrode, and a low impurity concentration region is disposed within a drain region of said second insulated gate transistor.

5. (Currently Amended) The semiconductor device as claimed in claim 1, wherein said second insulated gate transistor is a source follower transistor that constitutes a level shift circuit that generates a drive voltage applied to said first gate electrode through a CMOS circuit.

6. (Original) The semiconductor device as claimed in claim 1, wherein a well potential of said second insulated gate transistor is different from both a source potential and a drain potential.

7. (Original) The semiconductor device as claimed in claim 1, wherein a drain region of said second insulated gate transistor has a low impurity concentration region that is formed to be shallower than said first semiconductor region.

8. (Withdrawn) The semiconductor device as claimed in claim 1, wherein a drain region of said second insulated gate transistor has a low impurity concentration region having the same depth as that of said first semiconductor region.

9. (Withdrawn) The semiconductor device as claimed in claim 1, wherein said second semiconductor region is formed deeper than said first semiconductor region.

10. (Withdrawn) The semiconductor device as claimed in claim 9, wherein a plurality of first insulated gate transistors are arranged in an array without dedicated element isolation regions being interposed therebetween.

11. (Original) The semiconductor device as claimed in claim 1, wherein said second insulated gate transistor is an MOS transistor of the first conductive type which constitutes a low-voltage CMOS circuit.

12. (Withdrawn) The semiconductor device as claimed in claim 1, wherein said circuit for driving said switching element comprises a low-voltage CMOS circuit having said second insulated gate transistor, and a high-voltage CMOS circuit that is controlled by said low-voltage CMOS circuit; and

wherein an MOS transistor of the first conductive type which constitutes said high-voltage CMOS circuit is a DMOS transistor produced in the same process as that for forming said first insulated gate transistor.

13. (Withdrawn) The semiconductor device as claimed in claim 12, further comprising a level shift circuit that generates a drive voltage applied to said first gate electrode through said high-voltage CMOS circuit.

14. (Withdrawn, Currently Amended) The semiconductor device as claimed in claim 1, wherein said second insulated gate transistor includes source and drain regions of the first conductive type which are formed within ~~said well~~ a well of the second conductive type.

15. (Currently Amended) The semiconductor device as claimed in claim 1, wherein an electro-thermal converter that functions as said load is connected to a drain of said switching element and is integrated with said switching element.

16. (Original) The semiconductor device as claimed in claim 1, wherein said characteristic is at least one selected from a threshold value, a breakdown voltage and a substrate current.

17. to 20. (Cancelled)

21. (Currently Amended) ~~The semiconductor device as claimed in claim 17;~~
A semiconductor device in which a switching element for allowing a current to flow to a load and a circuit for driving said switching element are formed on a common substrate, wherein:
said switching element is formed of a DMOS transistor;
said circuit for driving said switching element includes an MOS transistor having
a characteristic different from that of said DMOS transistor; and

~~wherein~~ said MOS transistor is a source follower transistor that constitutes a level shift circuit that generates a drive voltage applied to a gate electrode of said DMOS transistor through a CMOS circuit.

22. (Cancelled)

23. (Currently Amended) ~~The semiconductor device as claimed in claim 17,~~

A semiconductor device in which a switching element for allowing a current to flow to a load and a circuit for driving said switching element are formed on a common substrate, wherein:

said switching element is formed of a DMOS transistor;

said circuit for driving said switching element includes an MOS transistor having a characteristic different from that of said DMOS transistor; and

~~wherein~~ a drain region of said MOS transistor has a low impurity concentration region formed to be shallower than a base region that becomes a channel of said DMOS transistor.

24. to 26. (Cancelled)

27. (Currently Amended) ~~The semiconductor device as claimed in claim 17,~~

A semiconductor device in which a switching element for allowing a current to flow to a load and a circuit for driving said switching element are formed on a common substrate, wherein:

said switching element is formed of a DMOS transistor;

said circuit for driving said switching element includes an MOS transistor having a characteristic different from that of said DMOS transistor; and

~~wherein~~ said MOS transistor is an MOS transistor of the first conductive type which constitutes a low-voltage CMOS circuit.

28. to 30. (Cancelled)

31. ~~(Currently Amended) The semiconductor device as claimed in claim 17;~~
A semiconductor device in which a switching element for allowing a current to flow to a load
and a circuit for driving said switching element are formed on a common substrate, wherein:
said switching element is formed of a DMOS transistor;
said circuit for driving said switching element includes an MOS transistor having
a characteristic different from that of said DMOS transistor; and
~~wherein~~ an electro-thermal converter that functions as said load is connected to a
drain of said DMOS transistor ~~into integration~~ and is integrated with said switching element.

32. ~~(Currently Amended) The semiconductor device as claimed in claim 17;~~
A semiconductor device in which a switching element for allowing a current to flow to a load
and a circuit for driving said switching element are formed on a common substrate, wherein:
said switching element is formed of a DMOS transistor;
said circuit for driving said switching element includes an MOS transistor having
a characteristic different from that of said DMOS transistor; and
~~wherein~~ said DMOS transistor comprises:
a first semiconductor region of a second conductive type disposed at one main
surface of a semiconductor substrate of a first conductive type;
a second semiconductor region of the first conductive type disposed within said
first semiconductor region;

a first gate electrode disposed on a surface in which a pn junction between said second semiconductor region and said first semiconductor region terminates, through an insulating film;

a first source region of the second conductive type which is disposed on one end portion side of said first gate electrode within said second semiconductor region; and

a first drain region of the second conductive type disposed within said first semiconductor region.

33. (Original) The semiconductor device as claimed in claim 1, wherein said second insulated gate transistor has an on resistance that is equal or greater, and an operation breakdown voltage that is $2/3$ or lower, as compared with those of said first insulated gate transistor.

34. (Original) The semiconductor device as claimed in claim 1, wherein said second insulated gate transistor has an on resistance that is equal or greater, and the maximum substrate current in an operation range which is 10 times or higher, as compared with those of said first insulated gate transistor.

35. (Currently Amended) ~~The semiconductor device as claimed in claim 17,~~
A semiconductor device in which a switching element for allowing a current to flow to a load and a circuit for driving said switching element are formed on a common substrate, wherein said switching element is formed of a DMOS transistor;

said circuit for driving said switching element includes an MOS transistor having a characteristic different from that of said DMOS transistor; and

wherein said MOS transistor has an on resistance that is equal or greater, and an operation breakdown voltage that is $2/3$ or lower, as compared with those of said DMOS transistor.

36. (Currently Amended) ~~The semiconductor device as claimed in claim 17;~~
A semiconductor device in which a switching element for allowing a current to flow to a load and a circuit for driving said switching element are formed on a common substrate, wherein said switching element is formed of a DMOS transistor;
said circuit for driving said switching element includes an MOS transistor having a characteristic different from that of said DMOS transistor; and

wherein said MOS transistor has an on resistance that is equal or greater, and the maximum substrate current in an operation range which is 10 times or higher, as compared with those of said DMOS transistor.

37. (Previously Presented) A liquid jet apparatus that jets a liquid by using a heat generated from an electro-thermal converter, said apparatus comprising:

a semiconductor device in which a switching element for allowing a current to flow to a load and a circuit for driving said switching element are formed on a common substrate, wherein said switching element is a first insulated gate transistor which comprises:

a first semiconductor region of a second conductive type disposed at one main surface of a semiconductor substrate of a first conductive type;

a second semiconductor region of the first conductive type disposed within said first semiconductor region;

a first gate electrode disposed on a surface in which a pn junction between said second semiconductor region and said first semiconductor region terminates, through an insulating film;

a first source region of the second conductive type which is disposed on one end portion side of said first gate electrode within said second semiconductor region; and

a first drain region of the second conductive type which is disposed within said first semiconductor region; and

wherein said circuit for driving said switching element comprises a second insulated gate transistor having a characteristic different from that of said first insulated gate transistor;

a discharge opening disposed in correspondence with said electro-thermal converter that becomes said load;

a container that contains said liquid that is supplied onto said electro-thermal converter; and

a power circuit for supplying a power voltage to said semiconductor device.

38. (Previously Presented) A liquid jet apparatus that jets a liquid by using a heat generated from an electro-thermal converter, said apparatus comprising:

a semiconductor device in which a switching element for allowing a current to flow to a load and a circuit for driving said switching element are formed on a common substrate, wherein:

said switching element is formed of a DMOS transistor; and

said circuit for driving said switching element includes an MOS transistor having a characteristic different from that of said DMOS transistor;

a discharge opening disposed in correspondence with said electro-thermal converter that becomes said load;

a container that contains said liquid that is supplied onto said electro-thermal converter; and

a power circuit for supplying a power voltage to said semiconductor device.

39. (Withdrawn, Currently Amended) A method of manufacturing a semiconductor device in which a switching element for allowing a current to flow to a load, and a circuit for driving said switching element are formed on a common substrate, said method comprising the steps of:

forming a first semiconductor region of a second conductive type ~~on a surface~~ at one main surface of a first conductive type semiconductor substrate;

forming a gate insulating film on said first semiconductor region;

forming a first gate electrode on ~~the surface~~ a surface of said first semiconductor region through said gate insulating film, and a second gate electrode on ~~the surface~~ a surface of said semiconductor substrate through said gate insulating film;

forming a second semiconductor region of a first conductive type which has a higher concentration than that of said first semiconductor region, within said first semiconductor region by ion implantation of first conductive type impurities ~~with~~ using said first gate electrode as a mask;

forming a lightly doped drain region of the second conductive type in said semiconductor substrate by ion implantation of impurities of the second conductive type, ~~with~~ using said second gate electrode as a mask; and

forming a first source region of the second conductive type ~~on~~ within said second semiconductor region at a surface side of said second semiconductor region by ion implantation ~~with~~ using said first gate electrode as a mask, forming a first drain region of the second conductive type ~~on~~ within said first semiconductor region at a surface side of said first semiconductor region, forming a second source region of the second conductive type ~~on~~ at a surface side of said semiconductor substrate by ion implantation, and forming a second drain region of the second conductive type so as to be apart from an end portion of said lightly doped drain region on the second gate electrode ~~side~~ side;

wherein said first gate electrode is disposed on a surface in which a pn junction between said second semiconductor region and said first semiconductor region terminates, through an insulating film;

wherein said first source region is disposed on one end portion side of said first gate electrode;

wherein said switching element is a first insulated gate transistor which comprises said first semiconductor region, said second semiconductor region, said first gate electrode, said

first source region, and said first drain region; and

wherein said circuit for driving said switching element comprises a second insulated gate transistor having a characteristic different from that of said first insulated gate transistor.

40. (Withdrawn, Currently Amended) The method of manufacturing a semiconductor device as claimed in claim 39, wherein said second semiconductor region is formed so as to be higher in concentration than said first semiconductor region and deeper than said first semiconductor region, in order to electrically insulate said first semiconductor region by ion implantation of the first conductive impurities ~~with~~ using said first gate electrode as a mask and a heat treatment.

41. (Withdrawn, Currently Amended) A method of manufacturing a semiconductor device in which a switching element for allowing a current to flow to a load, and a circuit for driving said switching element are formed on a common substrate, said method comprising the steps of:

forming a plurality of first semiconductor regions of a second conductive type ~~on a surface~~ at one main surface of a semiconductor substrate of a first conductive type;

forming a gate insulating film on said plurality of first semiconductor regions;

forming a first gate electrode on a surface of one of said plurality of first semiconductor regions through said gate insulating film, and a second gate electrode on a surface in which a pn junction between said semiconductor substrate and another one of said plurality of

first semiconductor regions terminates, through said gate insulating film;

forming a second semiconductor region of the first conductive type within said one of said plurality of first semiconductor regions by ion implanting impurities of the first conductive type, ~~with~~ using said first gate electrode as a mask;

forming a first source region of the second conductive type within said second semiconductor region at a surface side of said second semiconductor region by ion implanting impurities of the second conductive type ~~with~~ using said first gate electrode ~~on the surface side of said second semiconductor region~~ as a mask, forming a first drain region of the second conductive type ~~on~~ within said one of said plurality of semiconductor regions at a surface side of said one of said plurality of first semiconductor region, regions, forming a second source region of the second conductive type ~~on~~ at a surface side of said semiconductor substrate, and forming a second drain region of the second conductive type ~~on the~~ at a surface side of said another one of said plurality of first semiconductor region regions so as to be apart from a pn junction between said semiconductor substrate and said another one of said plurality of first semiconductor region regions;

wherein said first gate electrode is disposed on a surface in which a pn junction between said second semiconductor region and said one of said plurality of first semiconductor regions terminates, through said gate insulating film;

wherein said first source region is disposed on one end portion side of said first gate electrode;

wherein said switching element is a first gate insulated transistor which comprises said one of said plurality of first semiconductor regions, said second semiconductor region, said

first gate electrode, said first source region, and said first drain region; and

wherein said circuit for driving said switching element comprises a second insulated gate transistor having a characteristic different from that of said first insulated gate transistor.

42. (Withdrawn, Currently Amended) The method of manufacturing a semiconductor device as claimed in claim 41, wherein said second semiconductor region is formed so as to be higher in concentration than and deeper than said one of said plurality of first semiconductor ~~region and deeper than said first semiconductor region, regions,~~ in order to isolate one of said plurality of first semiconductor regions.

43. (Withdrawn) A liquid jet apparatus that jets a liquid by using a heat generated from an electro-thermal converter, said apparatus comprising:

a semiconductor device as claimed in claim 1; and

a discharge opening disposed in correspondence with said electro-thermal converter that becomes said load.

44. (Cancelled)